for anything else. Two points we must have before us if the scientific work is to be done for the purpose of attaining its chief end: we must as far as possible lose sight of study for either practical ends, or for the purpose of general information; and we must as far as possible adopt laboratory instruction. In regard to the first point, we suffer more in our academies and high schools, but perhaps also in our smaller colleges to a lesser extent, from rushing through these abbreviated courses in the sciences, than anywhere else; here it is chiefly that we find the task set of giving every student an outline view of every science, embracing as many diverse facts as his memory can hold. Particularly are the fairer sex compelled to suffer in this regard. Better far to take a single science and develop it much in the same way, though more systematically and to a more extended degree, as that already suggested for use in lower schools.

As regards the laboratory work, it may be very simple and inexpensive, but it is an invaluable aid in science teaching; a table, a dissecting case, a lens, a few glass jars, a few chemicals, and if possible a small microscope, slides and cover glasses, will form a sufficient equipment for a very practical biological laboratory; even some of these are not absolutely necessary, as the dissecting case may be replaced by a good knife. For botany the lens, or better the microscope, is almost alone needed; for mechanics, a few of the most familiar carpenters' tools and a bench for work, comprise the necessaries, while in the other branches of physics but little is needed. Even in electricity, a few pieces of copper and zinc, some old electric light carbons, a few chemicals, some wire and a magnet, will go a long way in instruction. Chemistry is supposed to require the largest outfit, and yet I think that some of our dealers in such goods could make no little profit by fitting up collections of chemicals and apparatus for the purposes we are considering, at the cost of not over a dollar for a full set for each student, and five times that amount for the teacher's set; in other words, expensive equipment is wholly unnecessary for elementary laboratory instruction in any of the sciences, indeed in too many cases, an extensive set of apparatus and fittings distracts the attention of the student from the experiment he is studying. Now in using the laboratory, let it be clearly understood that there is no "practical" aim sought, but merely that the student shall think out for himself all the facts connected with the experiment; if it be considered that a knowledge of certain facts is necessary to his education, let him be shown where in the dictionary or encyclopedia these facts may be found.

Our brains are limited in their capacity, and if we load them with that which is of little or no use, there will be little space left for that which is of more importance. Let the student know just where to go for these facts, rather than have his mind filled with them in preparation for examination day. Our aims in science study will be best attained by a few simple experiments, carefully studied and reasoned upon, and these every higher institution ought to furnish.

When we come to science instruction in college, the same train of reasoning applies, but here it is far easier to carry out our principles. It obtains in college, as in the lower institutions, that the student is expected to gain at least a smattering of the chief sciences; still, with our optional studies, the chance for obtaining the true aim of science study is far greater. One reason for this is the increased time allowed to each subject, and the fact that the teacher is more or less of a specialist in the branch or branches he teaches. Let us in this connection look a little more closely at the science with which I, as a teacher, am more familiar than any other, that of chemistry; for this will serve us as a type of them all. Chemistry is studied at college by two classes, one that desires to gain a thorough knowledge of the subject, usually for some practical end, and the other, generally comprising all the students who pass through college, desiring merely to gain a general view of the whole field. Since a thorough study of the chemistry of the non-metals is necessary as a foundation for further prosecution of the science, and since the time required to lay such a foundation is fully as much as the majority of the students can spend on the whole subject, it has been in many places in time past, and indeed perhaps we may say is to-day, the general plan to let the two divisions work in entirely different plans, the one class going superficially over the whole subject of chemistry in a term, while the other proceeds slowly and thoroughly. This is, I believe, a great mistake; the rapidly moving class is at just the same disadvantage as the academy and high school classes we have already noticed; they are trying to learn facts and statements, and thereby lose the true aim of science study. It would be far better for them by slow study to thoroughly master the principles of the science, and gain its value in stimulating thought, and in a few days' reading at a later period they could gain a far better knowledge of the whole subject than otherwise in the whole term. The student should, in the laboratory, perform after the professor each of the simpler experiments, and be questioned particularly and chiefly as to the meaning and signification of the experiment. In the quantitative laboratory he should study the metals comparatively, paying particular attention to similar reactions by which metals may be classed together, and to dissimilar reactions by which the metals may be distinguished and separated. In this way he may cut himself loose from all artificial tables except as far as he shall form these tables for himself as a result of his work (I may here perhaps be allowed, by way of parenthesis, to add that I believe it will be found more advantageous for the student, when beginning work on the metals, to examine first the effect of each of the common reagents upon all the metals, than the commonly adopted method of testing each metal with all the different reagents; in this latter case the student for the time being loses sight of comparative reactions).

The more thorough a student is in his work, the more he applies to it all his power of thought; the better his mind will be fitted to carry the science into practical work, should such be his ulterior aim. The more he works by rule, the less fitted will he be for more advanced work, and the less able to leave the beaten track.

The general principles here laid down in the study of chemistry, will be applicable to the other sciences. It will be better far for the student to cover less ground and to lay a thorough and thoughtful foundation; the further general knowledge of the subject will be easily and quickly gained whenever it may be desired. So too as regards the idea that a student should study at least a little of every science. To my mind it is better far to devote one's self thoroughly to one science or perhaps two in college; so similar are the methods of thought in them all, that he who has mastered one, can take up by himself any of the others sufficiently well to gain as much knowledge of it as a *liberal education* demands, while he who devotes himself in college equally to all will not only know little of any one, but he will almost, if not completely, have failed to gain the development of mind which science study should give him, and the superficial knowledge and facts gained will, for the most part, pass from his mind, as soon as examination day is over. With the scientific method of thought once gained, however, the facts in all other sciences, will naturally fall into such logical sequence that they will, for the most part, readily remain in the memory.

In summing up this paper let me repeat in conclusion that in my opinion, science study, to have its true value, must have ever before it from Common School to College, as its chief aim, the development of the power of thought; without this aim, it is time largely thrown away; with it, it is one of the most potent agencies in modern civilization.

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Polytechnical Society, Louisville, Ky.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Question of the Celts.

I REPLY with much pleasure to Professor Haynes's inquiries in *Science*, April 8, p. 207.

The theory of the European origin of the white race was advanced by Omalius D'Halloy (who is almost as well known for his labors in ethnology as in geology) in various papers published

previous to 1850 in the *Bulletins de l'Academie Royale de Belgique.* These must have been known to Dr. Latham, though he nowhere acknowledges indebtedness to them.

The work of Broca, in which he states that the Celts were a mixed type, is his "Nouvelles Recherches sur l'Anthropologie de la France." His words are, "C'est dans cette race mixte que se constitua plus de quinze siecles avant J. C. la nationalité des Celts."

In designating the ancient, blond, dolichocephalic people as Kymric, I follow the best French authorities, such as Dr. Collignon. The ancient Britons, Queen Boadicea and her subjects, were of this type. I cannot understand how Professor Haynes can say "all Celtic people now have black hair," in view of the type of the Scotch Highlanders and the Irish east of the Shannon. In reference to the invaders of Rome, I simply claimed that they spoke a Celtic dialect; I now go further and aver that, in the case of free tribes, speaking a dialect does prove blood relationship in all cases I know of. D. G. BRINTON.

Philadelphia, April 19.

The Question of the Artificial Production of Variations in Type.

ATTEMPTS have been made to modify the forms of animals, or produce new species, by deforming the parent, e.g., in the case of the attempt to produce a breed of short-tailed mice by mutilating the tails of the parents. Is this not beginning at the wrong end? Are not all transmitted variations transmitted by parents which were modified before birth? All successful attempts to produce and transmit modifications in the breed being the result of breeding from animals that have been congenitally modified, would it not seem the proper and only method to study the laws governing the modifications of the embryo and having discovered these, the production of modifications in species would be a matter of slight difficulty. Congenital variations are the result of law and not of chance. GERALD M. WEST.

Clark University, Worcester, Mass., April 17.

AMONG THE PUBLISHERS.

MESSRS. MACMILLAN & CO. have issued a second edition of Mr. A. R. Wallace's well-known "Island Life, or the Phenomena and Causes of Insular Faunas and Floras." The work has been carefully revised throughout, and, owing to the great increase in our knowledge of natural history of some of the islands during the last twelve years, considerable additions and alterations have been required.

— We have received a copy of the "Graphic Atlas and Gazetteer of the World," edited by J. G. Bartholomew, F.R.G.S., F.R.S.E., and published by Thomas Nelson & Sons. It is an entirely new atlas, with over 220 maps, charts, plans of cities, etc., all revised to the present date. A most valuable feature is the Gazetteer of of the World, with nearly 55,000 places, specially complete in American names, and results of new census. In the United States section a separate map is given of each of the States and Territories, specially compiled from the latest Government Survey Maps. In proportion to its contents this volume is quite unique among atlases for compactness and portability. It is of quarto size, bound in half-morocco, gilt top, and sold at the very moderate price of $7.50.

— Both admirers and critics of Spencer will be interested in the paper on "Herbert Spencer and the Synthetic Philosophy," in the May *Popular Science Monthly.* The writer, Mr. William H. Hudson, was formerly private secretary of Mr. Spencer, and gives an insight into the process by which his philosophic thought unfolded. The paper contains also a statement of the relation between the work of Darwin and that of Spencer. Professor Frederick Starr will contribute some "Notes upon Anthropological Work in Europe," telling what museums and other facilities for the study of anthropology exist abroad. The article is illustrated with twelve portraits of leading European anthropologists. "Cave-Dwellings of Men" is the subject of a copiously illustrated article by Mr. W. H. Larrabee. It relates not only to the ancient cave-dwellings of America and the Old World, but describes also the way in which modern troglodytes are living in several parts of Europe to-day. In an article on "Evolution in Folk-Lore," Mr. David Dwight Wells gives two versions of a negro legend nearly a century apart in time, which show the alterations produced in the tale by the change from free life in Africa to slave life in America. An Index to Volumes I. to XL. of *The Popular Science Monthly* is well advanced in preparation, and will be published in the course of the coming summer. The entire contents of the forty volumes will be entered both by author and by subject in one alphabetical list, and the Index will have all the most approved features of the latest magazine indexes, besides some novel ones. The compiler is Mr. Frederik A. Fernald of the editorial staff of the *Monthly.*

— *Nature* notices the appearance of a very useful work, in Russian, by Professor Samokvasoff, on Russian prehistoric antiquities, under the title of "Foundations of a Chronological Classification of Antiquities, and Catalogue." As seen from the title, the work consists of two parts: a catalogue of the very rich collection of the Russian professor, partly illustrated, and a general description of the various epochs which may be distinguished in the relics of the past on the territory of Russia. He has no difficulty in showing that the Slavonians of the first centuries of our era were by no means mere savages. The burial places of that period, usually situated close to the earthern forts, some of which must have required the work of a considerable population, contain hundreds and thousands of graves, so that it is certain that the Slavonians of that period were living in large societies, and had their fortified towns. The same burial customs prevailed over large areas, but the treasures now unearthed from various graves show that differences of wealth and social position existed at that time as well. Considerable amounts of Greek, Roman, and Arabian gold and silver coins were found in the graves, the metal alone of the coins found in some graves attaining, at its present prices, the value of several hundred pounds; while numbers of objects of art, of Greek, Roman, Byzantine, and Arabian origin, are proofs of the brisk foreign trade which took place at that time. The graves of the pagan Slavonians contain flax, woollen, silk, and gold-embroidered tissues; ornaments in gold, silver, bronze, and bone; iron weapons and parts of armament; gold, silver, bronze, iron, and clay vessels, and so on; while the sickles and the grains of wheat, oats, and barley which were found in the graves of South Russia, together with small idols and other objects devoted to pagan worship, are proofs of agriculture having been carried on during the pagan epoch.

INDUSTRIAL NOTES.

Scientific Improvements.

It has been the good fortune of an American firm, J. W. Queen & Co., of Philadelphia, to furnish an epoch-making contrivance for those who have to use the lantern at varying distances from the screen. The NEW MULTIFOCAL ATTACHMENT, which they have wisely protected by patent, is the most valuable accessory that has ever been offered to the exhibitor and lecturer. It consists of *an achromatic* combination of lenses which is placed just behind the ordinary projection objective. This new accessory, having been prepared after a special formula, is so delicately adapted to its work that its curves help to correct and improve the definition of the objective, but the principal purpose of this new accessory, as expressed by its name, *multifocal*, is to provide many points of image production in the range of the objective, each image point giving a different size of picture for the screen, according to the desired distance. In common experience the lecturer is obliged to set the instrument at one invariable distance from the screen, or else carry several screens of different sizes. Every one can appreciate the relief offered by the Multifocal Attachment, which allows complete liberty of choice for the station of the lantern with only one screen. The exhibitor can now literally "cut his coat according to his cloth," and diminish or increase the size of his picture so as neatly to cover the screen at any distance. It is simply impossible to express the satisfaction and freedom from care which the possession of